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SITE PREPARATION SAVINGS THROUGH BETTER UTILIZATION STANDARDS[1]

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ABSTRACT.--This paper reports preliminary results of a study to determine the savings in the cost of site preparation that can be accomplished by the intensive utilization of understory biomass. mechanized systems can potentially be used for recovering this material.

INTRODUCTION

Most current conventional harvesting operations leave usable biomass to be windrowed and burned. In the southeastern United States the typical management strategy is to clearcut mature stands, to mechanical site prepare, and to replant the site. Clearcutting involves the removal of wood which can be delivered to market at a profit with the equipment available. In the southeastern United States, the pine component of the stand will be the most completely utilized. The tops and stems less than 6 inches dbh are left to be disposed of during the subsequent site preparation operations. Usually, sawlogs are the only hardwood component harvested from the stand, since the demand for hardwood pulp is so weak. The limby tops and hardwood stems less than 12 inches dbh are left on the clearcut area.

Much of the research effort addressing the recovery of this unutilized material has centered around the development of machines whose sole function is the recovery of biomass after harvest or site preparation and on unmerchantable stands. The Koch-Nickolson and Georgia-Pacific's Jaws II machines are examples of this effort. Both of these machines have found limited success.

In the past conventional systems were economically constrained from complete recovery of biomass due to the demand for the harvested product but the potential for improved utilization is high. High speed feller bunchers have accumulating ability to handle large numbers of small stems more efficiently than other feller bunchers. These feller bunchers can produce bundles of small stems which are equivalent in weight to bundles of merchantable stems. These bundles of up to 100 small stems can be easily handled by grapple skidders. Portable chippers have revolutionized the utilization of the entire tree. Young (1980) reported that portable chipping has established the usefulness of tops for energy fiber. Chippers also increase utilization of defective small trees. Thus, if markets exist for chips produced from the previously unutilized material, then current highly

This paper reports preliminary results from a study which addressed the opportunities for reducing site preparation costs by more intensive utilization during harvest using equipment currently being used in harvesting timber. The study was accomplished in two phases. One phase was quantifying the harvesting costs associated with reducing residue during harvest. The second phase dealt with assessing costs with various site preparation methods and various levels of harvesting residue.

Three harvesting methods were evaluated in two stands. The study was designed so that each harvesting method was studied on two twenty-acre blocks. Harvesting methods tested were:

1) Conventional - harvest all "merchantable" stems as roundwood,
2) Two-pass - preharvest the stems that are unmerchantable by chipping them for hogfuel and then conventionally harvest the merchantable stems as roundwood in a second pass over the stand, and
3) One-pass - harvest the hogfuel and roundwood simultaneously.

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The one-pass system was able to capture the tops of the roundwood and convert it into chips also. Site preparation treatments were imposed following each harvesting method which would leave a suitable situation for planting the next stands. The site preparation treatments tested following each harvesting method are shown in Figure 1.

METHODS

The results of tests conducted in two pine plantations are reported in this paper. Tests are also being conducted in a natural stand but data collection is not yet complete. The two tracts in the tests were 22 year old slash pine plantations that were being clearcut for pulpwood. Both were in south Alabama but were in different locations. Each tract was divided into three harvesting blocks that were 660 ft. wide and 1,320 ft. deep. The 20 acre blocks were the same configuration to maintain average skidding distances among the harvesting methods (see Fig. 1).

A preharvest cruise was conducted to determine the standing inventory of each block. Fixed radius tenth-acre plots were established to sample trees larger than the 3 inch dbh class. In the center of these plots, a two-hundredth acre fixed radius subplot was taken to determine the standing woody biomass for all trees in the 1-3 inch dbh classes. Destructive sampling was used on the 1/200 acre plots and the total green weight was recorded for each tree. All heights were measured in the subplots and sampled in the plots. Summary preharvest inventorys are shown in Table 1.

After the block perimenters were well established and the stand information obtained, each block was harvested. Harvesting took place from June through August of 1983. Servis recorders were mounted on each machine used in the operation. Recorder disks were collected daily to obtain the number of productive hours each machine operated on each block. A monitor maintained a record of crew hours for each block. Each truckload was weighed at the mill to obtain the amount of harvested material by product (see Table 1). A post harvest inventory was taken in the same manner as the preharvest cruise. During the post harvest inventory, all of the residual biomass in the 1/200 acre plot was also weighed. A summary of the information is also shown in Table 1.

Mechanical site preparation activities were monitored in the same manner as the harvesting activities. Servis recorders were used to collect the time required for the machines to accomplish each of the treatments on each harvested block. The herbicide applications were made by the cooperator under a test designed by the Herbicide Cooperative at Auburn University. Since the effectiveness and equivalence of the herbicide treatments to the mechanical treatment is not known, the information on the herbicide treatments is not included. This information will be available at a later date.

Realistic standardized hourly machine and labor rates were used along with machine usage information to develop a total cost for harvesting each block and for performing each site preparation treatment on each block. A harvesting cost per green ton was calculated using the total harvesting cost and the inventory of the material harvested (see Table 2).

RESULTS

The conventional harvesting method removed only 59% of the estimated volume on the site as opposed to 81% for the two-pass method and 90% for the one-pass method (see Table 1). The residual biomass to be removed during site preparation amounted to 21.4 tons per acre following the conventional method as opposed to 4.5 tons per acre and 3.4 tons per acre following the one and two-pass methods respectively. Thus, it was obvious that a greater site preparation effort was required following the conventional method of harvest.

A key to using the intensive harvest methods to reduce site preparation costs was that the cost of harvesting must not increase dramatically. The average costs of harvesting all material actually decreased for the two methods which were more intensive in the recovery of biomass (Table 2). The two intensive methods actually had lower costs for the component of the harvest that is normally taken during a conventional harvest of merchantable stems (Table 3). This came about for the two-pass because the feller-buncher and skidders did not have to maneuver around the usual understory and had park-like conditions in which they could operate. The feller-buncher crossed the area only once in the one-pass method and thus only a portion of its travel time could be charged to the roundwood portion of the harvest with the remainder being charged to the hogfuel being harvested.

This study was initiated under the hypothesis that harvesting the understory material for hogfuel could not be done profitably, and harvesting this increment of material could be attractive if a credit for site preparation cost reduction was added to the income from hogfuel. The cost of harvesting the incremental material into chip vans was found to be \$8.32/green ton for the one pass method and \$12.41/green ton for the two pass method. The chips as a hogfuel had a trade-off value of \$15/green ton with natural gas; thus the chips harvested by the one pass method could be hauled a greater distance and still break even with natural gas. The important finding is that the value of the incremental material was greater than its harvesting cost (at certain haul distances), and thus, the one and two pass methodologies were feasible for producing hogfuel even without credits for site preparation cost reductions or credits for reduced costs in harvesting the roundwood portion of the stand.

The estimated mechanical site preparation costs following each of the harvest methods is shown in Table 3. Assuming that all mechanical site preparation treatments were equally effective, a site preparation credit was calculated for the reduction in site preparation cost accounted for by the incremental volume removed during harvest by the one and two-pass methods. (Visual inspections 9 months after site preparation indicate that this assumption is not unfounded. On neither site did the shear-rake-pile-disc treatment following the conventional harvest method have less vegetation than the double disc treatment following the one or two-pass harvesting methods.) The credits were calculated by taking the reduction in site preparation cost from that obtained following a conventional harvest and dividing by the tons of chips generated. Note that the credit for the one-pass is higher than the credit for the two-pass. This is due to the fact that there was less chipable material in the stands harvested by the one-pass method. It would be reasonable to expect the credits to be equal for either harvest method.

CONCLUSIONS

These preliminary results indicate that conventional harvesting systems can be used to economically harvest the understory biomass when there is a market for the biomass as fuel nearby. The harvesting methodologies utilized during the tests were similar to those commonly used in the region. Thus, it is reasonable to expect that these results can be duplicated in other localities. The site preparation credits that could be allocated to the chips harvested by one or two-pass methods will enable the methods to be utilized at even greater haul distances, beyond the distance which is a break-even point with the alternative fuel source.

When completed, this study will have information of this type from natural stands in Mississippi. Harvesting costs for the natural stands have been found to be almost identical to those reported here. Many other factors in this problem area must be further evaluated before the total answer to this opportunity is known. The authors intend to study the sensitivity of these costs to the quantity of understory material in the stand. The authors also intend to look at more efficiently organizations for conventional harvesting operations for simultaneous production of biomass for fuel and conventionally merchantable roundwood.

LITERATURE CITED

Young, Harold E. 1980. Woody Fiber Plus Machines Equals Availability. APA/TAPPI Committee on Whole Tree Utilization, 5 p.

TYPE OF HARVEST

CONVENTIONAL		TWO-PHASE	ONE-PHASE
KG and Pile		Single Disk	Single Disk
10 Acres	Chemical	5 Acres	5 Acres
	10 Acres	Double	Double Disk
		5 Acres	5 Acres
		Chemical	Chemical
		5 Acres	5 Acres
		Control (No Site Prep)	Control (No Site Prep)
		5 Acres	5 Acres

Figure 1.--Plot layout of test blocks.

Table 1.--Inventory of Test Blocks.

Harvest Treatment	Total Biomass	Unmerchantable Material in a Conventional Operation	Material Harvested	Residual Biomass
	Green Tons Per Acre			
Conventional	85.5	29.0	50.7	21.4
One Pass	84.9	19.7	76.7	4.5
Two Pass	91.3	32.8	74.3	3.4

Table 2.--Average harvesting costs for all material removed.

Harvesting Treatment	Harvesting Cost[1] (US Dollars/Green Ton)
Conventional	$9.99
One Pass	7.57
Two Pass	8.93

[1]Harvesting costs are for felling, skidding, delimbing (if necessary) and chipping or loading.

Table 3.--Site preparation costs.

Harvest Treatment	Site Prep Treatment	Site Prep Cost (US $/Acre)	Site Prep Credit To Incremental Volume[1] (US $/Green Ton)
Conventional	Shear-Rake-Pile-Disc	$95.56	--
One Pass	Single Disc	18.81	6.67
	Double Disc	37.56	5.04
Two Pass	Single Disc	19.18	4.83
	Double Disc	38.36	3.62

[1]Assuming site preparation treatments were equally effective.